Green and Sustainable Remediation in the Navy's Environmental Restoration Program

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Environment, Energy Security, & Sustainability Symposium
Denver, CO
June 14-17, 2010

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUN 2010		**00-00-2010 to 00-00-2010**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Green and Sustainable Remediation in the Navy's Environmental Restoration Program	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Facilities Engineering Service Center,1100 23rd Street,Port Hueneme,CA,93043**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 14-17 June 2010 in Denver, CO.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**24**	

New Executive Order and DoD Guidance

- EO 13514 – October 5, 2009 Federal Leadership in Environmental, Energy, and Economic Performance
  - GSR related major elements: Improve energy efficiency; reduce GHG emissions, water consumption, & waste generation; promote renewable energy, recycling, & community enhancements

- DoD Memorandum August 10, 2009 - Consideration of Green and Sustainable Remediation (GSR) practices in the Defense Environmental Restoration Program
  - Evaluate opportunities for GSR during all phases of remediation
  - Implement these opportunities when and where these make sense
  - Track and report progress

What is GSR?

- GSR employs strategies for cleanups that:
  - Use natural resources and energy efficiently
  - Reduce negative impacts on the environment
  - Minimize or eliminate pollution at its source
  - Protect and benefit the community at large
  - Reduce waste to the greatest extent possible
- GSR minimizes the environmental “footprint” of cleanup actions
- Environmental footprint refers to the impacts on environmental media and society

Green and Sustainable Remediation

DON Programmatic Approach

- DON remains focused on conducting cleanups in accordance with CERCLA and the NCP
  - –GSR considerations bring a more holistic approach to site cleanup while remaining endpoint focused
  - –Environmental, social, and economic impacts considered during remedy selection are rolled into existing NCP criteria
- Implementing GSR as part of the DON's existing optimization program
  - –Optimization reviews (required by DON policy) are opportune times to evaluate green/sustainable methods
  - –Consider GSR throughout the cleanup process: Key points include Remedy Selection, Remedial Design, and System Operation
  - –Consider sustainability when developing performance objectives and exit strategies

Green and Sustainable Remediation
DON Programmatic Approach

- DON Optimization Workgroup tasked to develop and promote GSR approach, implementation, and information
- Emphasized in NAVFAC Technology Transfer Plan for Environmental Restoration 2010 – 2014
  - "Incorporating Optimization and Sustainable Environmental Remediation Practices" is one of the top 8 technical challenges
- Communicating efforts with other Federal partners, state regulators, and industry through FRTR, ITRC, SuRF, & ASTM

Where does a Sustainability Evaluation Fit in the CERCLA Process?

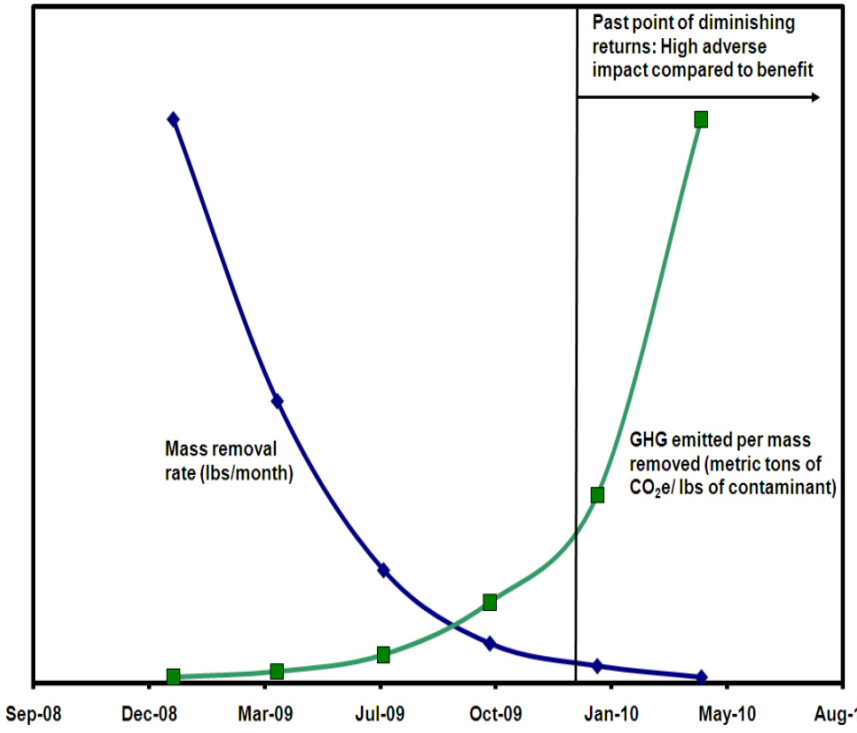
- Nine criteria for detailed analysis of remedial alternatives
  - Overall protection of human health and the environment
  - Compliance with ARARs
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility or volume through treatment
  - **Short-term effectiveness**
  - Implementability
  - Cost
  - State acceptance
  - Community acceptance

- **Adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy**
- **Time for remedy implementation**

Incorporating GSR into the Cleanup Process

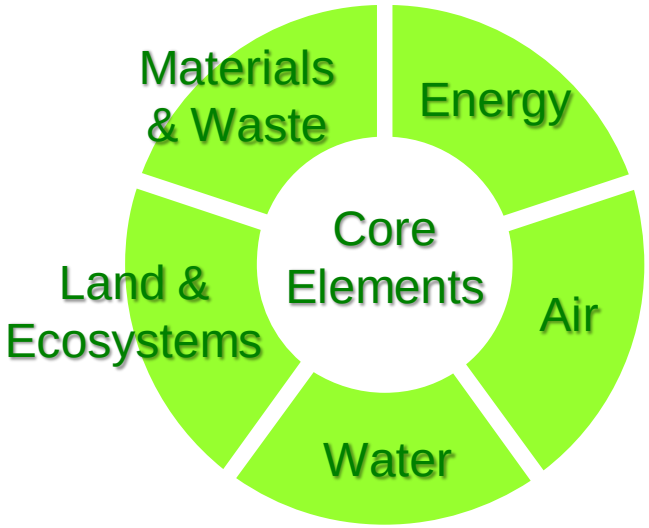
- Minimize environmental footprint of site cleanups
- Most effective stages to apply GSR is during remedy selection and implementation of exit strategies

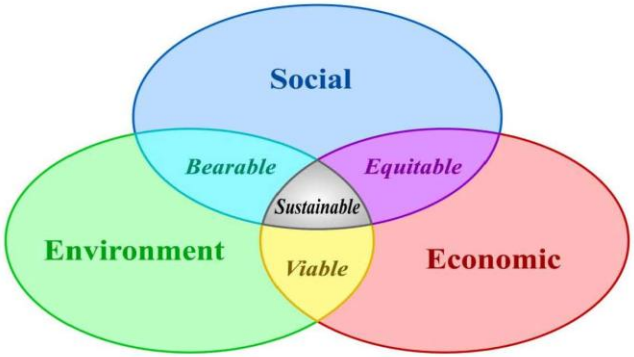
- Avoid operating remedial systems beyond point of diminishing returns as this increases environmental footprint with little remedial benefit



GSR Evaluation Metrics

- DON Optimization Workgroup decided on the following metrics:
  - –Energy Consumption
  - –GHG Emissions
  - –Criteria Pollutant Emissions
  - –Water Usage
  - –Worker Safety
  - –Resource Consumption
    - Waste Generation
  - –Ecological Impacts
  - –Community Impacts
- For operating remedies, include Kwh used and GHG emission per lb contaminant removed
  - –Could also include other relevant metrics





Navy GSR Evaluation Case Studies

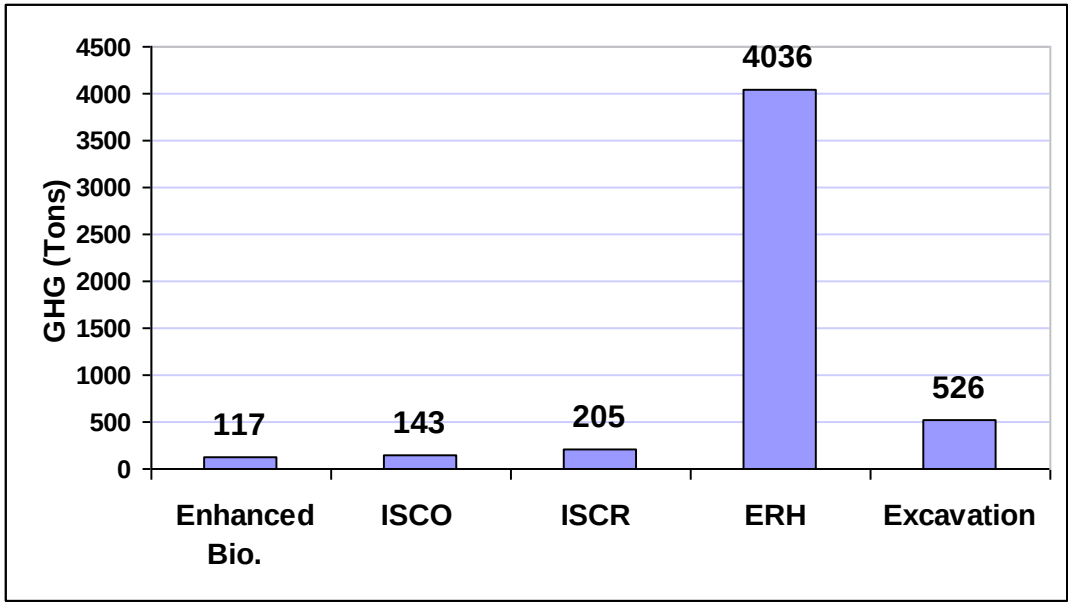
- Case studies for lessons learned - 6 completed, 1 in progress
  - Former Naval Air Station (NAS) Alameda, CA (two OUs)
  - NAS Meridian, MS
  - Marine Corps (MC) Recruit Training Center, Parris Island, SC
  - MC Logistics Base, Albany, GA
  - Naval Aviation Depot, Norfolk, VA
  - Yorktown Fuel Depot, Yorktown, VA (in progress)
- Two case studies in remedial action operation phase
- Five case studies in remedy selection phase

Project Approach

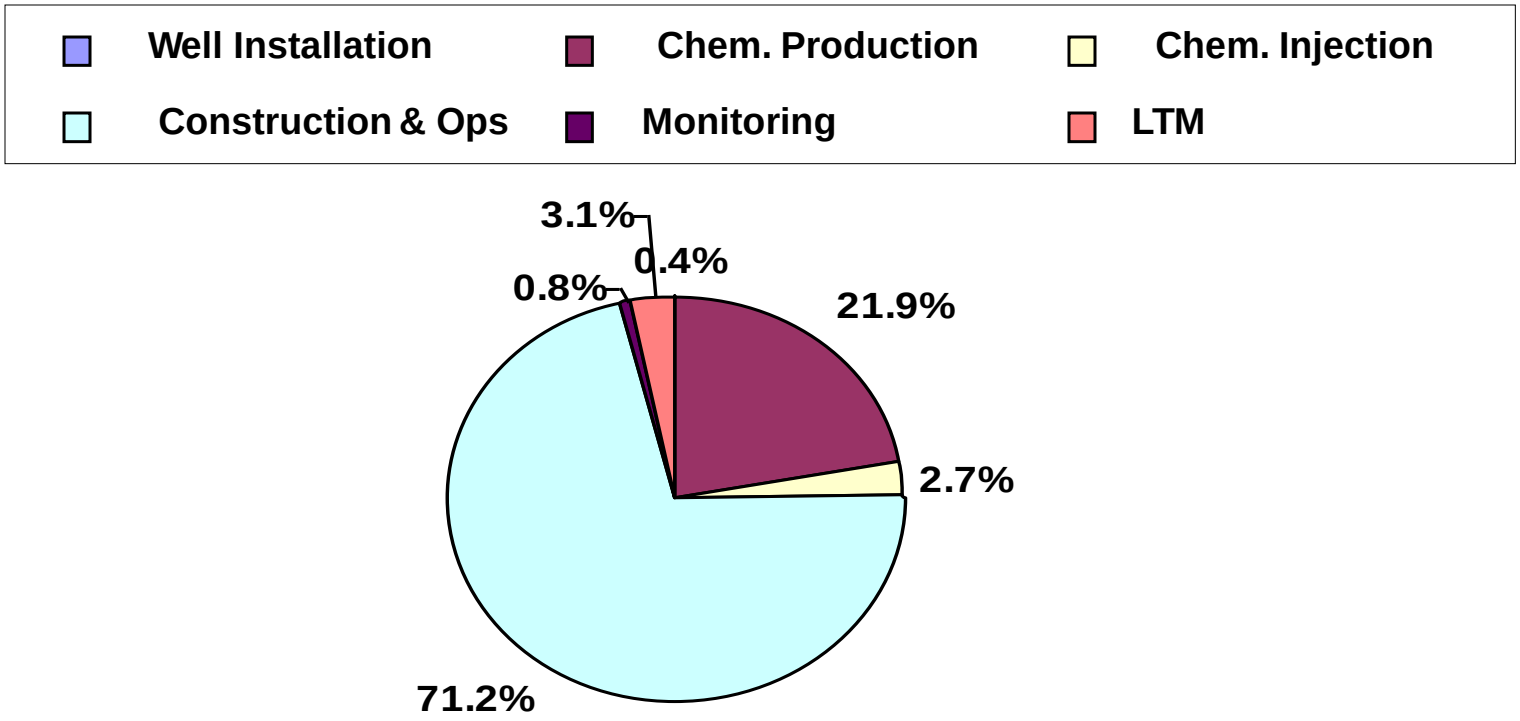
1. Determine which sustainability metrics should be considered for the site;
2. Establish and apply a methodology to quantify or characterize each metric;
3. Obtain consensus regarding how metrics are weighed against each other and against traditional criteria in selecting the remedial approach;
4. Identify methods to reduce environmental footprint of remedy components; and
5. Prioritize, select, and document what footprint reduction methods should be implemented with consideration of the overall net environmental benefit and available funding.

Observations from Case Studies - GHG Emissions

- All case studies included GHG emissions - CO_2, CH_4, and N_20
- Reported as CO_2e
- Mostly related to energy consumption
- For commonly used in situ remedies (active), In situ bio tends to have low GHG emissions



ISCO - GHG Emissions from Various Activities



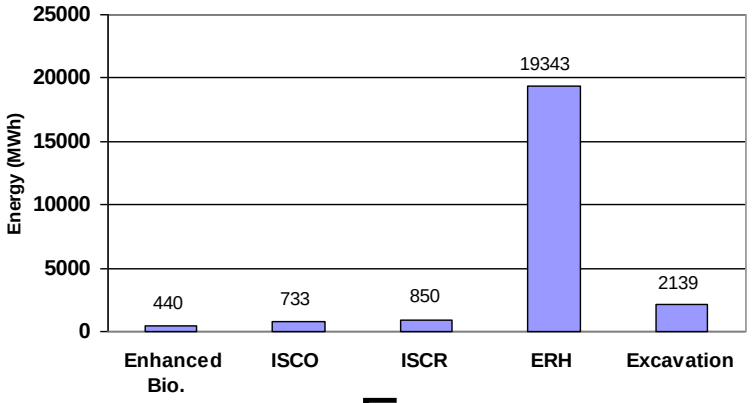
- Production of chemicals / supplies used at remediation sites could have significant contribution for GHG footprint

- Two case studies did not include GHG emissions from production of chemicals / supplies

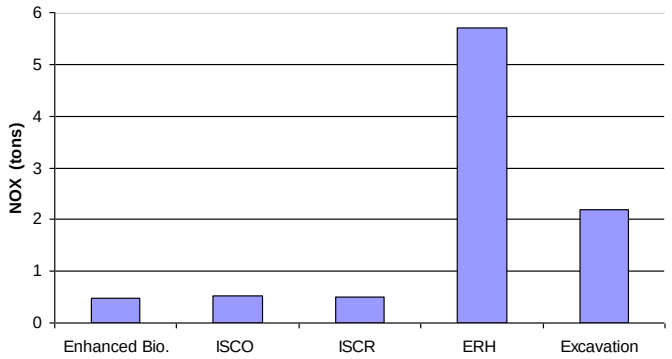
What is Included in GHG Calculation for each Activity?

- Consumables
- Transportation Personnel
- Transportation Equipment / Materials
- Equipment Use - earthwork, pumps, compressors
- Residual Handling - soil, water, sludge

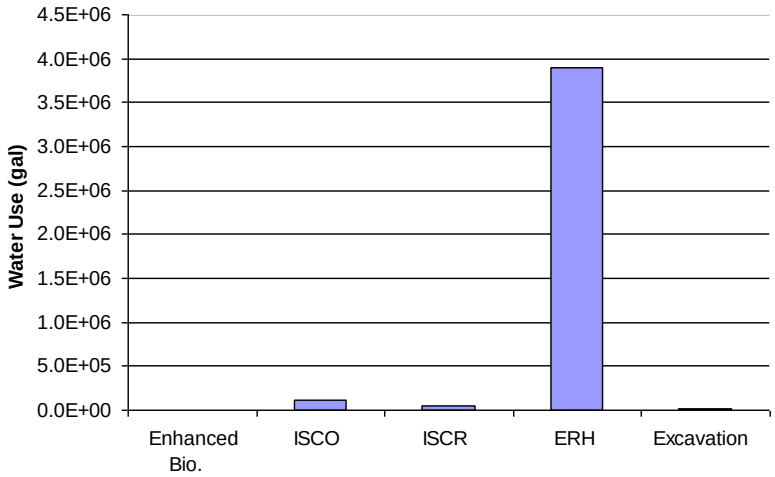
Other Metrics from Case Studies



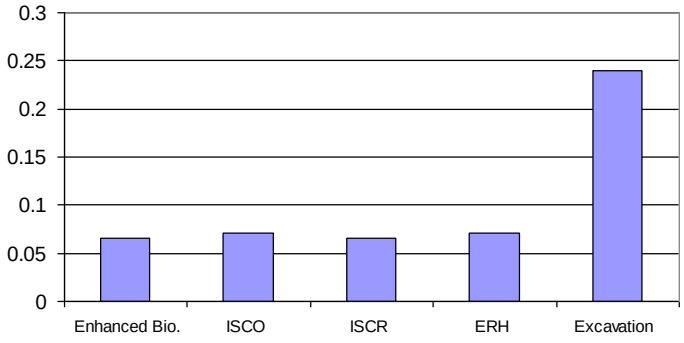
Energy



Air Pollutants



Water Usage



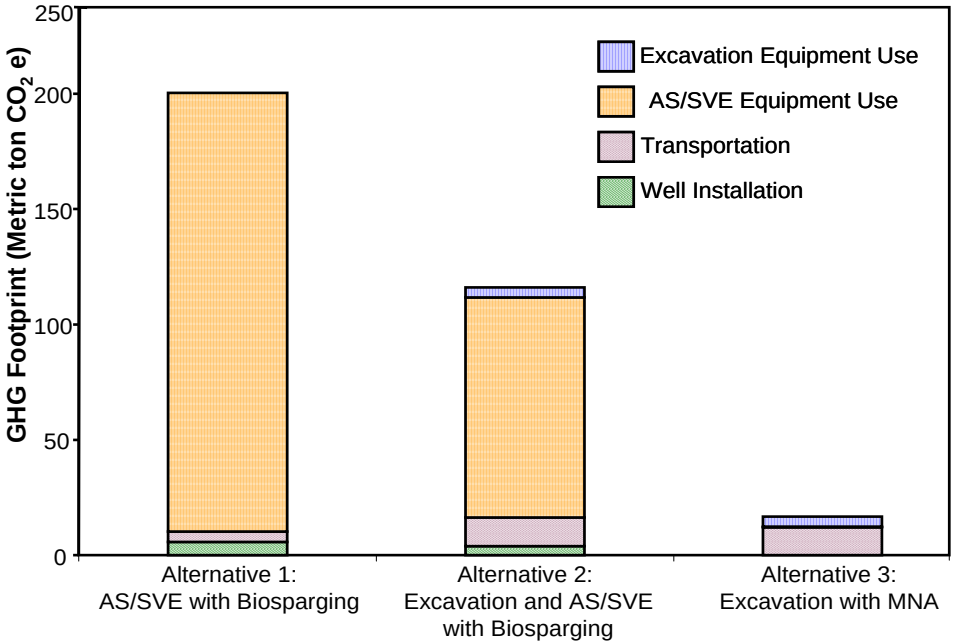
Injury

Typical High Footprint Activities

Activity	Metrics Most Impacted
Transportation for materials and waste as well as personnel during RA-O & LTMgt	**Emissions of GHGs, criteria pollutants, consumption of energy, accident risk (particularly death)**
Operation of mechanical equipment (e.g. pumps, blowers, compressors)	**Emissions of GHGs, criteria pollutants, consumption of energy**
Drilling/Well installation	**Emissions of GHGs, criteria pollutants, consumption of energy, accident risk (particularly injury)**
Consumption of chemicals or other materials (e.g. oxidants, ZVI, biostimulants, GAC)	**Emissions of GHGs, consumption of energy**

SiteWise™

- SiteWise™ Tool - released May 2010
- Collaborative effort between Army, Navy, and Battelle
- Calculates the environmental footprint of remedial alternatives
- MS Excel-based
- Metrics evaluated:
  - –Greenhouse gases
  - –Air quality parameters
  - –Energy consumption
  - –Water consumption
  - –Worker accident risk
- No cost for use
- Available to the public at http://www.ert2.org/t2gsrportal



GHG Footprint of the Remedial Alternatives Considered at NAS Meridian

SiteWise™ Data Input Sheet

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value

MATERIAL PRODUCTION ☑ For inputting data for other options in Material Production, please check this box.

WELL MATERIALS	Well Type 1	Well Type 2
Input number of wells		
Input depth of wells (ft)		
Choose well diameter (in) from drop down menu	1/2	1/2
Choose material type from drop down menu	Steel	Steel
Choose specific material schedule from drop down menu	Schedule 40 Steel	Schedule 40 Steel

TREATMENT CHEMICALS	Treatment 1	Treatment 2

SiteWise™ Calculation

PUMP OPERATION - For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pumps or unused methods

USER INPUT		Pump 1	Pump 2	Pump 3	Pump 4
Method 1 - IF NAME PLATE SPECIFICATIONS ARE KNOWN					
USER INPUT	***Input Pump horsepower (hp)***	0	0	1	5
USER INPUT	***Input Number of pumps operating***	1	0	2	6
USER INPUT	***Input Operating Time for each pump (hrs)***	10	0	3	7
	Input Pump Load	0.8	0.8	0.8	0.8
	Input Pump Motor Efficiency	0.9	0.9	0.9	0.9
Method 2 - IF PUMP HEAD IS KNOWN					
USER INPUT	***Input flow rate (gpm)***	0	0	0	0
USER INPUT	***Input total head (ft)***	0	25	0	0
USER INPUT	***Input Number of pumps operating***	0	1	0	0
USER INPUT	***Input Operating Time for each pump (hrs)***	0	4	0	0
	Input pump Efficiency	0.6	0.6	0.6	0.6
	Input specific gravity	1	1	1	1
	Pump horsepower (hp)	0.00	0.00	0.00	0.00
Method 3 - IF ELECTRICAL USAGE IS KNOWN					
USER INPUT	***Input Pump Electrical Usage (KWh)***	1000	0	0	0
Select Region					
USER INPUT	***Choose Region from Figure 1***	AKGD	AKMS	AZNM	CAMX
	CO_2 emission factor (lb/MWH)	1232	499	1311	724
	CH_4 emission factor (lb/MWH)	0.0256	0.02075	0.01745	0.03024
	N_2O emission factor (lb/MWH)	0.00651	0.00408	0.01794	0.00808
	NOx emission factor (lb/MWH)	2.480	6.791	2.111	0.618
	SOx emission factor (lb/MWH)	1.214	0.526	1.081	0.531
	ENERGY OUTPUT				
	Energy Usage (KWh)	1.0E+03	0.0E+00	4.0E+00	1.4E+02
	Energy Usage (MWH)	1.0E+00	0.0E+00	4.0E-03	1.4E-01
	Energy Usage (BTU)	8.5E+06	0.0E+00	3.4E+04	1.2E+06
	CO_2 OUTPUT				
	CO_2 emission (metric ton)	5.6E-01	0.0E+00	2.4E-03	4.6E-02
	N_2O emission (metric ton CO_2 e)	9.2E-04	0.0E+00	1.0E-05	1.6E-04
	CH_4 emission (metric ton CO_2 e)	2.4E-04	0.0E+00	6.6E-07	4.0E-05
	NOx and SOx OUTPUT				
	NOx emission (metric ton)	1.1E-03	0.0E+00	3.8E-06	3.9E-05
	SOx emission (metric ton)	5.5E-04	0.0E+00	2.0E-06	3.4E-05

TOTAL FROM PUMP OPERATION	
CO_2 Emission (metric ton)	**6.1E-01**
Energy Used (MWh)	**1.1E+00**
Energy Used (MMBTU)	**9.8E+00**
Water Usage (gal)	**5.8E+02**
NOx Emission (metric ton)	**1.2E-03**
SOx Emission (metric ton)	**5.9E-04**

Major Information Sources

- EPA climate leaders GHG inventory protocol core module guidance
- World Resources Institute
- World Business Council for Sustainable Development
- EPA Mobile 6
- EPA non-road model
- EPA eGRID
- GaBi LCA software
- Eco Profiles from various European industry sources

  - Various groups are developing additional information
  - Need to frequently update emission factors used in GSR evaluations

DON GSR Web Portal

Available at www.ert2.org

Green and Sustainable Remediation Fact Sheet and Web Training Tool

- Issued August 2009 by the DON Optimization Workgroup
- Sustainability metrics
- Footprint assessment methods
- Incorporating GSR into the Environmental Restoration Process
- Footprint reduction methods


NAVFAC
Naval Facilities Engineering Command

ENVIRONMENTAL RESTORATION

Green and Sustainable Remediation Fact Sheet

Introduction to GSR (What, Why, How)

What is Green and Sustainable Remediation?
Sustainable practices are those that consider economic and natural resources, ecology, human health and safety, and quality of life. Although the terms green and sustainable are sometimes used interchangeably, green remediation can be considered as having a focus on environmental factors, whereas green and sustainable remediation (GSR) is of a more holistic view and considers not only environmental factors, but social responsibility (e.g., minimizing risk to surrounding communities) aspects as well.

GSR expands upon current environmental practices and employs strategies for cleanups that use natural resources and energy efficiently, reduce negative impacts on the environment, minimize or eliminate pollution at the source, protect and benefit the community at large, and reduce waste to the greatest extent possible, thereby minimizing the environmental "footprint" and maximizing the overall benefit of cleanup actions. The term environmental footprint refers to the impacts on environmental media and society that are a direct or indirect consequence of performing the remedial action.

Opportunities to increase sustainability can be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout) regardless of the selected cleanup remedy. However, it is anticipated that the greatest opportunities to reduce the footprint of the Navy Environmental Restoration Program (NERP) are associated with the remedy selection process. While it must be emphasized that meeting the traditional requirements of remediation (e.g., protection of human health and the environment and compliance with applicable or relevant and appropriate requirements) is still of primary importance, there are significant differences in the environmental footprint among alternatives that meet these requirements, and those remedies with the lesser footprint should be viewed more favorably.

Why now?
Consideration of sustainable practices is becoming increasingly important throughout the remediation community and this emphasis is now being reflected in policy and guidance. Executive orders (EOs) 13514 released on October 8, 2009 and 13423 released on January 26, 2007 mandate inclusion of sustainability and sustainable practices in all the activities of federal agencies. Furthermore, a memorandum released by the Department of Defense (DoD) in August of 2009 states that the DoD is committed to conduct its environmental program in a sustainable manner, in line with EO 13423. The memorandum requests every DoD component to apprise the office of Under Secretary of Defense by December 2009 about the initiatives undertaken by all the DoD components for implementing green and sustainable options in their environmental restoration programs. In addition, Department of the Navy (DON) Environmental Strategy lays out a vision for "Sustaining our Environment, Protecting our Freedom," which links accomplishing the Navy's war fighting mission with its responsibility to safeguard the natural systems upon which the nation's quality of life depends. Furthermore, regulatory agencies are beginning to request that sustainability be considered during remedy implementation. The Navy remedial project manager (RPM) that applies GSR is able to show compliance with EOs 13423 and 13514, DoD GSR Memorandum, and the DON Environmental Strategy, as well as reduced life-cycle costs and improved community and regulatory acceptance of remedies with lower overall impacts.

How do I apply GSR to my site?
Although the remediation industry is placing an emphasis on GSR and various relevant publications have been produced (a listing of references is provided in the **spring 2009 NAVFAC RPM newsletter**), no accepted protocols currently exist for implementing GSR. GSR should be considered during (a) evaluation of remedies during the remedy selection process, (b) the remedial design phase, and (c) optimization of remedial actions during the remedial action operation phase. The DON Optimization Workgroup is developing a strategy for applying GSR to the remediation process as part of the optimization program. Until guidance is available, an RPM may consider the following general approach:

- Determine which sustainability metrics should be considered for the site;
- Establish and apply a methodology to quantify or characterize each metric;
- Obtain consensus regarding how metrics are weighed against each other and against traditional criteria in selecting the remedial approach;
- Identify methods to reduce environmental footprint of remedy components; and
- Prioritize, select, and document what footprint reduction methods should be implemented with consideration of the overall net environmental benefit and available funding.

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Fact sheet available from:
http://www.ert2.org/t2gsrportal

Green and Sustainable Remediation Additional DON Products

Training

- Spring 2010 RITS (7 locations)
  - –GSR Overview and SiteWise™ Tool
- CECOS Remedy Optimization and Site Closeout Course (2 per yr)
  - –Being updated to include GSR considerations

Guidance

- Guidance for Optimizing Remedy Evaluation, Selection, and Design (updated March 2010)
- Guidance for Optimizing Remedial Action Operations (planned update to include GSR in 2011)
- New guidance for GSR
  - –Underway with planned completion by EOY 2010

Case Studies

- Completed six case studies and one underway
- Lessoned learned to be included in guidance, training, and other resources

Summary

- DON aggressively taking actions to integrate green and sustainable practices within all phases of remediation
- DON Optimization workgroup developing resources
- SiteWise™ is a valuable tool for quantifying the environmental footprint of remedial alternatives
- DON metrics include GHG emissions, energy usage, criteria air pollutants, ecological impacts, water usage, resource consumption, worker safety, and community impacts
- DON working with other agencies for sharing lessons learned and developing consistent approaches
- DON developing a guidance for evaluating and implementing GSR


Questions